We claim:

1. A MIMO-OFDM transmitter adapted to transmit a header symbol format in which sub-carriers of a header OFDM symbol are divided into a non-contiguous set of sub-carriers for each of a plurality of antennas, with each antenna transmitting the header OFDM symbol only on the respective set of sub-carriers.

2. A transmitter according to claim 1 wherein there are N antennas and a different set of sub-carriers separated by N sub-carriers is assigned to each of the plurality of antennas.

3. A transmitter according to claim 1 wherein the header symbols contain a multiplexed dedicated pilot channel on dedicated pilot channel sub-carriers and common synchronization channel on common synchronization channel sub-carriers for each of the plurality of antennas.

4. A transmitter according to claim 3 wherein the header OFDM symbols further contain multiplexed broadcasting sub-carriers for each of the plurality of antennas.

5. A transmitter according to claim 1, adapted to transmit a preamble having a prefix, followed by two identical OFDM symbols having said header OFDM symbol format.

6. A transmitter according to claim 5 wherein the prefix is a cyclic extension of the two identical OFDM symbols.

7. A transmitter according to claim 3 wherein the pilot channel sub-carriers have a BTS specific mapped complex sequence allowing efficient BTS identification.

8. A transmitter according to any one of claims 3 wherein the common synchronization channel is designed for fast and accurate initial acquisition.

9. A transmitter according to claim 3 wherein the common synchronization channel is used for course synchronization and fine synchronization and the pilot channel is used for fine synchronization.

10. A transmitter according to claim 3 wherein the common synchronization channel is used to transmit a complex sequence which is different for each transmit antenna of one transmitter, but which is common for respective transmit antennas of different transmitters within a communications network.

11. A transmitter according to claim 1 adapted to transmit OFDM frames beginning with said preamble, and having scattered pilots throughout a remainder of the OFDM symbols in each OFDM frame.

12. A transmitter according to claim 1 wherein during the preamble, for each of N transmit antennas, dedicated pilot channel sub-carriers are transmitted and common synchronization channel sub-carriers are transmitted and broadcasting channel sub-carriers are transmitted.

13. A transmitter according to claim 3 wherein the sub-carriers of the preamble OFDM symbols are organized as a repeating sequence of {dedicated pilot channel for each of N transmit antennas, common synchronization channel sub-carrier for each of N transmit antennas} arranged in a predetermined order.

14. A transmitter according to claim 4 wherein the sub-carriers of the preamble OFDM symbols are organized as a repeating sequence of {at least one dedicated pilot channel

sub-carrier for each of N transmit antennas, at least one common synchronization channel sub-carrier for each of N transmit antennas, at least one broadcast channel sub-carrier} arranged in a predetermined order.

15. A MIMO-OFDM receiver adapted to receive a header symbol format in which sub-carriers of a header OFDM symbol are divided into a non-contiguous set of sub-carriers for each of a plurality of antennas, with each antenna transmitting the header OFDM symbol only on the respective set of sub-carriers.

16. A receiver according to claim 15 adapted to receive from N transmit antennas with a different set of sub-carriers separated by N sub-carriers assigned to each of the plurality of transmit antennas.

17. A receiver according to claim 15 wherein the header OFDM symbols contain multiplexed dedicated pilot channel sub-carriers and common synchronization channel sub-carriers for each of the plurality of transmit antennas.

18. A receiver according to claim 17 wherein the header OFDM symbols further contain multiplexed broadcasting carriers for each of the plurality of antennas.

19. A receiver according to claim 15 adapted to receive a preamble having a prefix, followed by two identical OFDM symbols having said header OFDM symbol format.

20. A receiver according to claim 15 wherein the dedicated pilot channel has a BTS specific mapped complex sequence, the receiver being adapted to perform BTS identification on the basis of the dedicated pilot channel.

21. A receiver according to claim 19 wherein the dedicated pilot channel have a BTS specific mapped complex sequence, the receiver being adapted to perform BTS identification on the basis of the dedicated pilot channel.

22. A receiver according to claim 21 wherein the header OFDM symbols contain multiplexed dedicated pilot channel sub-carriers and common synchronization channel sub-carriers for each of the plurality of transmit antennas, the receiver being further adapted to perform course synchronization on the common synchronization channel by looking for a correlation peak between consecutive OFDM symbols which are identical.

23. A receiver according to claim 22 further adapted to perform fine synchronization on the basis of the common synchronization channel sub-carriers and/or the dedicated pilot channel sub-carriers.

24. A transmitter adapted to transmit a packet data frame structure comprising:

a superframe having a length corresponding to a synchronization period of a network;

the superframe containing a plurality of radio frames;

each radio frame containing a plurality of TPS (transmission parameter signalling) frames corresponding to an adaptive coding and modulation period;

each TPS frame containing a plurality of slots corresponding to an air interface slot size;

each slot containing a plurality of OFDM symbols, with the first two symbols of the first slot of the first

TPS frame of each OFDM frame being used as header OFDM symbols.

25. A transmitter according to claim 24 wherein the header OFDM symbols have a header OFDM symbol format in which sub-carriers of a header OFDM symbol are divided into a non-contiguous set of sub-carriers for each of a plurality of antennas, with each antenna transmitting the header OFDM symbol only on the respective set of sub-carriers.

26. A transmitter according to claim 24 wherein the header OFDM symbols contain multiplexed pilot channel sub-carriers and common synchronization channel sub-carriers for each of the plurality of antennas.

27. A transmitter according to claim 24 wherein the header OFDM symbols further contain multiplexed broadcasting channel sub-carriers for each of the plurality of antennas.

28. A transmitter according to claim 24 adapted to transmit in a plurality of different modes by transmitting a different number of OFDM symbols per slot with an unchanged slot duration and with no change to the frame structure above the slot.

29. A transmitter according to claim 28 wherein modes with an increased number of OFDM symbols per slot are realized by shortening OFDM symbol duration, and shortening FFT size, but not changing sampling frequency.

30. A transmitter according to claim 24 adapted to transmit to a respective set of users for each TPS frame and to signal for each TPS frame which users should demodulate the entire TPS frame.

31. A receiver adapted to receive and process OFDM frames transmitted by the transmitter of claim 24.

32. A method of performing synchronization at an OFDM receiver comprising:

at each of at least one receive antenna, sampling a received signal to produce a respective set of time domain samples;

determining at least one course synchronization position;

at each of the at least one receive antenna:

a) for each of a plurality of candidate fine synchronization positions about one of said at least one course synchronization position:

i) for each receive antenna positioning an FFT window to the candidate fine synchronization position and converting by FFT the time domain samples into a respective set of frequency domain components;

ii) for each said at least one transmit antenna, extracting a respective received training sequence corresponding to the transmit antenna from the sets of frequency domain components;

iii) for each transmit antenna, calculating a correlation between each respective received training sequence and a respective known transmit training sequence;

iv) combining the correlations for the at least one transmit antennas to produce an overall correlation result for each candidate synchronization position;

b) determining a fine synchronization position from the plurality of correlation values;

combining the fine synchronization positions from the at least one receive antenna in an overall fine synchronization position.

33. A method according to claim 32 wherein a course synchronization position is determined for each receive antenna and used for determining the respective fine synchronization position.

34. A method according to claim 32 a course synchronization position is determined for each receive antenna and an earliest of the positions is used determining the fine synchronization positions for all receive antennas.

35. A method according to claim 33 wherein the course synchronization position is determined in the time domain for at least one receive antenna by looking for a correlation peak between the time domain samples over two OFDM symbol durations.

36. A method according to claim 32 applied at an OFDM receiver having at least two antennas, combining the fine synchronization positions from the at least one receive antenna in an overall fine synchronization position comprises selecting an earliest of the fine synchronization positions.

37. A method according to claim 32 wherein:

sampling a received signal to produce a set of time domain samples is done for at least three OFDM symbol durations;

determining at least one course synchronization position comprises performing a course synchronization in the time domain by looking for a correlation peak between

the time domain samples received over two OFDM symbol durations to identify a course synchronization position by:

a) calculating a plurality of correlation values, each correlation value being a correlation calculated between a first set of time domain samples received during a first period having one OFDM symbol duration and a second set of time domain samples received during a second period immediately following the first period and having OFDM symbol duration, for each of a plurality of starting times for said first period;

b) identifying the course synchronization position to be a maximum in said plurality of correlation values.

38. A method according to claim 32 wherein:

combining the correlations for the at least one transmit antennas to produce an overall correlation result for each candidate synchronization position comprises multiplying together the correlations for the at least one transmit antenna for each candidate synchronization position.

39. A method according to claim 32 applied to a single transmit antenna single receive antenna system.

40. A method according to claim 32 wherein the training sequence is received on common synchronization channel sub-carriers.

41. A method according to claim 32 wherein the training sequence is received during an OFDM frame preamble.

42. A method according to claim 32 wherein the training sequence is received on dedicated pilot channel sub-carriers.

43. A method according to claim 42 wherein the training sequence is received during an OFDM frame preamble.

44. An OFDM receiver comprising:

at least one receive antenna;

for each said at least one receive antenna, receive circuitry adapted to sample a received signal to produce a respective set of time domain samples;

a course synchronizer adapted to determine at least one course synchronization position;

a fine synchronizer comprising at least one FFT, at least one correlator and at least one combiner, adapted to, at each of the at least one receive antenna:

a) for each of a plurality of candidate fine synchronization positions about one of said at least one course synchronization position:

i) for each receive antenna position an FFT window to the candidate fine synchronization position and convert by FFT the time domain samples into a respective set of frequency domain components;

ii) for each said at least one transmit antenna, extract a respective received training sequence corresponding to the transmit antenna from the sets of frequency domain components;

iii) for each transmit antenna, calculate a correlation between each respective received training sequence and a respective known transmit training sequence;

iv) combine the correlations for the at least one transmit antennas to produce an overall

correlation result for each candidate synchronization position;

b) determine a fine synchronization position from the plurality of correlation values;

the receiver being further adapted to combine the fine synchronization positions from the at least one receive antenna in an overall fine synchronization position.

45. A receiver according to claim 44 having at least two receive antennas, adapted to combine the fine synchronization positions from the at least one receive antenna in an overall fine synchronization position by selecting an earliest of the fine synchronization positions.

46. A receiver according to claim 44 adapted to combine the correlations for the at least one transmit antennas to produce an overall correlation result for each candidate synchronization position by multiplying together the correlations for the at least one transmit antenna for each candidate synchronization position.

47. A receiver according to claim 44 adapted to receive the training sequence on common synchronization channel sub-carriers.

48. A receiver according to claim 44 adapted to receive the training sequence on dedicated pilot channel sub-carriers.

49. A method of performing fine synchronization comprising:

at each at least one receive antenna receiving OFDM symbols containing a respective received frequency domain training sequence for each of at least one transmit antenna;

performing fine synchronization in the frequency domain by looking for maximum correlations between known frequency domain training sequences and the received frequency domain training sequences.

50. A method of transmitting signals enabling fine synchronization comprising:

from each of at least one transmit antenna, transmitting OFDM symbols containing a respective frequency domain training sequence.

51. A method according to claim 50 wherein a different frequency domain training sequence is transmitted by each transmit antenna, but the same frequency domain training sequence is transmitted by corresponding antenna of other transmitters.

52. A method of performing cell selection at an OFDM receiver comprising:

at each of at least one receive antenna, sampling a received signal to produce a respective set of time domain samples;

determining at least one course synchronization position;

at each of the at least one receive antenna:

a) performing a frequency domain correlation between at least one received common synchronization sequence extracted from common synchronization channel sub-carriers in the received signal and a corresponding common synchronization sequence of a respective plurality of transmit antennas to identify a plurality of candidate correlation peaks;

b) selecting the M strongest correlation peaks for further processing;

c) at each correlation peak, reconverting time domain samples into frequency domain components and processing pilot channel sub-carriers, these containing transmitter specific information, to identify a transmitter associated with each correlation peak;

d) determining a C/I or similar value for each transmitter thus identified;

selecting the transmitter having the largest C/I determined for any of the at least one receive antenna.

53. A method according to claim 52 wherein performing a frequency domain correlation between at least one received common synchronization sequence extracted from common synchronization channel sub-carriers in the received signal and a corresponding common synchronization sequence of a respective plurality of transmit antennas to identify a plurality of candidate correlation peaks comprises:

a) for each of a plurality of candidate fine synchronization positions about one of said at least one course synchronization position:

i) for each receive antenna positioning an FFT window to the candidate fine synchronization position and converting by FFT the time domain samples into a respective set of frequency domain components;

ii) for each of at least one common synchronization sequence, each common synchronization sequence having been transmitted by a transmit antenna of each of at least one transmitter, extracting a respective

received training sequence corresponding to the transmit antennas from the sets of frequency domain components;

iii) for each of the at least one common synchronization sequence, calculating a correlation between each respective received common synchronization sequence and a respective known common synchronization sequence;

iv) combining the correlations to produce an overall correlation result for each candidate synchronization position;

b) determining at least one peak in the correlations, each said at least one peak being local maxima in the correlations.

54. A method according to claim 53 further comprising:

reconverting time domain samples into frequency domain components based on the fine synchronization position of the selected transmitter and performing a further fine synchronization based on a dedicated pilot channel for that transmitter.

55. A method according to claim 54 applied to a MIMO-OFDM frame format having a header symbol format in which subcarriers of a header symbol are divided into a non-contiguous set of subcarriers for each of a plurality of antennas, with each antenna transmitting header symbols only on the respective set of sub-carriers, and wherein the header symbols contain multiplexed pilot channel sub-carriers and common synchronization channel sub-carriers for each of the plurality of antennas, the frame beginning with two identical header OFDM symbols during which contents of the pilot channel sub-carriers are repeated and contents of the synchronization channel sub-carriers are repeated, the

common synchronization channel sub-carriers carrying a complex sequence which is different for respective antenna of one base station and being common across multiple base stations, and contents of the dedicated pilot channel sub-carriers being at least locally unique to a particular base station.

56. A method according to claim 52 further comprising:

for transmitter switching, averaging the C/I or similar value over a time interval for each transmitter thus identified, and at the end of the time interval instigating a transmitter switch to the transmitter with the largest average C/I or similar value if different from a currently selected transmitted.